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LAKE BUTTE DES MORTS, WINNEBAGO COUNTY, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

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Wisconsin Department of Natural Resources
Wisconsin National Guard

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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REPORT

ON

LAKE BUTTE DES MORTS

WINNEBAGO COUNTY

WISCONSIN

EPA REGION V

WORKING PAPER No. 35

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

JANUARY, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conduct of the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

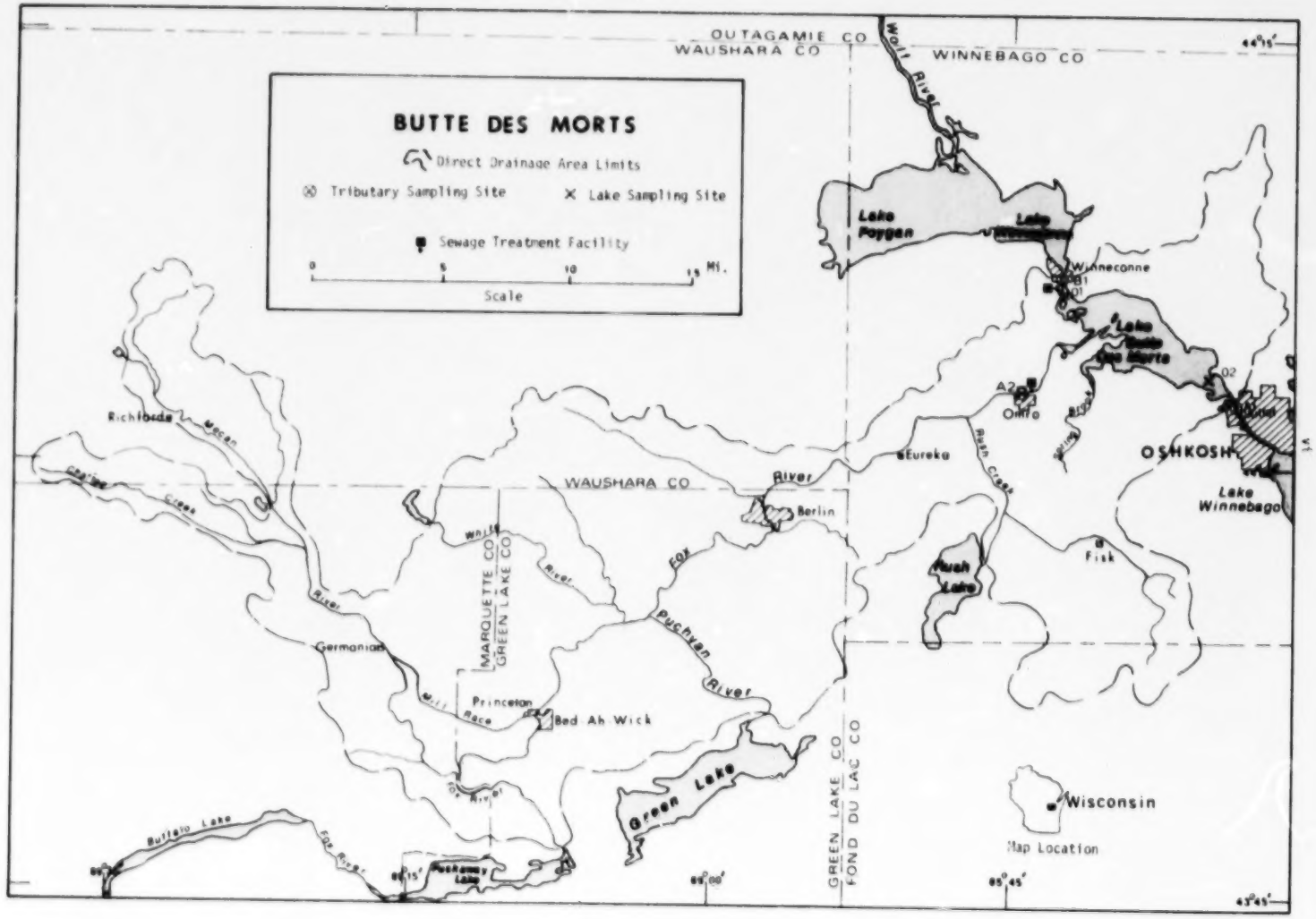
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano

LAKE NAME	COUNTY
Sinnissippi	Dodge
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


BUTTE DES MORTS
Direct Drainage Area Limits
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 5 10 15 Mi.
Scale
OUTAGAMIE CO
WAUSHARA CO
WINNEBAGO CO
Wolf River
Lake Poygan
Lake Winneconne
Winneconne
Lake Butte des Morts
Omro
Eureka
Rush Creek
OSHKOSH
Lake Winnebago
Fisk
Rush Lake
Berlin
Fox River
Puchyan River
White River
MARQUETTE CO
GREEN LAKE CO
Germania
Princeton
Bad Ah Wick
Green Lake
Buffalo Lake
Puckaway Lake
FOND DU LAC CO
Wisconsin
Map Location

LAKE BUTTE DES MORTS

STORET NO. 5508

I. CONCLUSIONS

A. Trophic Condition:

Lake Butte des Morts is shallow and very eutrophic and historically has always been a eutrophic lake, although according to Sloey (1970), since 1966 it has changed from a clear-water lake dominated by aquatic macrophytes and bog-like areas to a rather turbid water body from which aquatic plants and bog areas are disappearing.

B. Rate-Limiting Nutrient:

The results of the algal assay indicate Lake Butte des Morts was limited by nitrogen at the time the sample was taken. The lake data indicate nitrogen limitation in June and August also.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Lake Butte des Morts received a total phosphorus load at a rate five times the rate proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 14). While it is probable that Vollenweider's model is not applicable to a lake with such a short hydraulic retention time, the trophic condition of the lake is evidence of excessive nutrient loadings.

It is estimated that the two point sources considered in this study contributed only about 1% of the total phosphorus load. If only these sources were considered, it would be concluded that point-source phosphorus control would not significantly improve the trophic condition of Lake Butte des Morts. However, it is known that there are point sources in the Fox River drainage (Schraufnagel et al., 1967) and in the Wolf River drainage (McKersie et al., 1971) beyond the 25-mile limit of the Survey*, and it appears that a more detailed study is needed to assess the effectiveness of point-source phosphorus control elsewhere in the Fox and Wolf river drainages.

2. Non-point sources (see page 13)--During the sampling year, the phosphorus exports of the Fox and Wolf rivers were quite high and are indicative of the unmeasured point sources noted above.

It is calculated that the mean phosphorus export of the two drainages would have to be reduced to about 28 lbs/mi^2/yr to result in a loading rate just equal to a eutrophic rate.

* See Working Paper No. 1, "Survey Methods".

II. INTRODUCTION

Lake Butte des Morts is a moderate-sized shallow reservoir located at the confluence of the Fox River and the Wolf River in Winnebago County, Wisconsin; the lake is a part of the Winnebago Pool complex.

The lake has good public access and commercial facilities are available. The fishery is represented by muskellunge, northern pike, walleye, bass, and panfish (Anonymous, 1972).

Vegetation in the watershed is characterized by oak savanna, and the predominant industries are dairy and vegetable farming.

Lake Butte des Morts is listed in "Problem Lakes in the United States" where it is characterized as being a shallow, naturally eutrophic lake located in an area which is subjected to high nutrient loadings from agricultural runoff. An additional problem cited for Lake Butte des Morts is bog loss during high water which results in nutrient release to the waters of the lake.

Sloey (op. cit.) indicated that the waters in the lakes of the Winnebago Pool were once clear and were dominated by floating and emergent aquatic vegetation; however, in recent years the lakes and the river channel have become consistently turbid, and the emergent vegetation and bog areas are disappearing.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 8,857 acres.
2. Mean depth: 6 feet.
3. Maximum depth: 9 feet.
4. Volume: 53,142 acre-feet.
5. Mean hydraulic retention time: 6 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Fox River	1,600.0 mi^2	1,225.0 cfs
Wolf River	3,900.0 mi^2	2,875.1 cfs
Minor tributaries & immediate drainage -	66.2 mi^2	29.9 cfs
Totals	5,566.2 mi^2	4,131.0 cfs

2. Outlet -

Fox River	5,580.0 mi^2**	4,131.0 cfs

C. Precipitation***:

1. Year of sampling: 33.3 inches.
2. Mean annual: 25.1 inches.

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† Ball, 1973.
* Drainage areas are accurate within ±0.5%; mean daily flows are accurate within ±40%; mean monthly flows are accurate within ±35%; and normalized monthly flows are accurate within ±35%.
** Includes area of lake.
*** See Working Paper No. 1.

IV. LAKE WATER QUALITY SUMMARY

Lake Butte des Morts was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the two stations for phytoplankton identification and enumeration; and during the first visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 4 feet at both stations.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (11/09/72)		
Temperature (Cent.)	5.6	5.7	5.7	5.9
Dissolved oxygen (mg/l)	10.5	10.8	10.8	11.0
Conductivity (μmhos)	310	325	325	340
pH (units)	7.9	7.9	7.9	8.0
Alkalinity (mg/l)	137	140	140	142
Total P (mg/l)	0.028	0.061	0.067	0.083
Dissolved P (mg/l)	0.030	0.031	0.030	0.033
NO_2 + NO_3 (mg/l)	0.310	0.345	0.340	0.390
Ammonia (mg/l)	0.070	0.077	0.075	0.090
		ALL VALUES		
Secchi disc (inches)	17	23	21	30

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/22/72	1. Melosira	4,661
	2. Polycystis	1,448
	3. Flagellates	1,312
	4. Cyclotella	1,131
	5. Dinobryon	814
	Other genera	2,670
	Total	12,036
08/20/72	1. Anabaena	14,595
	2. Melosira	10,000
	3. Lyngbya	7,297
	4. Polycystis	811
	5. Fragilaria	721
	Other genera	1,351
	Total	34,775
11/09/72	1. Scenedesmus	3,216
	2. Dinobryon	2,060
	3. Melosira	1,809
	4. Flagellates	1,608
	5. Pediastrum	1,558
	Other genera	1,910
	Total	12,161

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/22/72	01	21.0
	02	9.0
08/20/72	01	30.8
	02	22.1
11/09/72	01	51.9
	02	17.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.027	0.336	6.7
0.006 P	0.033	0.336	6.7
0.012 P	0.039	0.336	7.3
0.024 P	0.051	0.336	7.2
0.060 P	0.087	0.336	7.8
0.060 P + 10.0 N	0.087	10.336	33.4
10.0 N	0.027	10.336	8.9

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that Lake Butte Des Morts was nitrogen limited at the time of sampling; however, the nitrogen limitation was borderline. A slight decrease in phosphorus or

increase in nitrogen in the sample would have produced a phosphorus limited condition as indicated by the control N/P ratio of just over 12/1.

The lake data indicate nitrogen limitation in June and August, 1972 (N/P ratios were less than 14/1) but a borderline condition in November with station 1 having an N/P ratio slightly greater than 14/1.

D. Trophic Condition:

Survey data indicate that Lake Butte des Morts is eutrophic. Of the 46 Wisconsin lakes sampled, 18 had less mean total phosphorus, 16 had less mean dissolved phosphorus, 19 had less mean inorganic nitrogen, 32 had less mean chlorophyll a, and 40 had greater Secchi disc transparency.

Survey limnologists observed algal blooms in progress during all sampling visits and noted the occurrence of emergent aquatic vegetation in the shallow shoreline areas.

V. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Wisconsin National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in September, 1972, and was completed in August, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Wisconsin District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the means of the annual nutrient loads, in lbs/mi^2/year, in the Fox and Wolf rivers and multiplying the means by the ZZ area in mi^2.

The communities of Omro and Winneconne did not participate in the Survey, and nutrient loads were estimated at 2.5 lbs P and 7.5 lbs N/capita/year.

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* See Working Paper No. 1.

A. Waste Sources†:

1. Known muncipal -

Name	Pop.* Served	Treatment	Mean** Flow (mgd)	Receiving Water
Omro	2,341	prim. clarifier	0.234	Fox River
Winneconne	1,608	prim. clarifier	0.161	Lake Butte des Morts

2. Industrial - There are a number of food-processing industries in the Fox and Wolf river drainages. These nutrient sources were not sampled, and the nutrient contributions to Lake Butte des Morts are not known.

† Schraufnagel et al., 1967; McKersie et al., 1971.
* 1970 Census.
** Estimated at 100 gal/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Fox River	211,850	27.9
Wolf River	527,330	69.4
b. Minor tributaries & immediate drainage (non-point load) -	8,870	1.2
c. Known municipal STP's -		
Omro	5,850	0.8
Winneconne	4,020	0.5
d. Septic tanks* -	460	<0.1
e. Industrial - Unknown	?	-
f. Direct precipitation** -	1,380	0.2
Total	759,760	100.0

2. Outputs -

Lake outlet - Fox River 811,270

3. Net annual P loss - 51,510 pounds

* Estimate based on 736 shoreline dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/yr	% of total
a. Tributaries (non-point load) -		
Fox River	4,744,800	33.1
Wolf River	9,268,300	64.7
b. Minor tributaries & immediate drainage (non-point load) -	176,820	1.2
c. Known municipal STP's -		
Omro	17,560	0.1
Winneconne	12,060	0.1
d. Septic tanks* -	17,390	0.1
e. Industrial - Unknown	?	-
f. Direct precipitation** -	85,330	0.7
Total	14,322,260	100.0

2. Outputs -

Lake outlet - Fox River 14,404,140

3. Net annual N loss - 81,880 pounds

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs $P/mi^2/yr$	lbs $N/mi^2/yr$
Fox River	132	2,966
Wolf River	135	2,376

* Estimate based on 736 shoreline dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with very short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	85.8	loss*	1,617.1	loss*
grams/m^2/yr	9.61	-	181.2	-

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Butte des Morts:

"Dangerous" (eutrophic rate)	1.92
"Permissible" (oligotrophic rate)	0.96

* There was an apparent and unexpected loss of both phosphorus and nitrogen during the sampling year. It is believed the "loss" resulted from the intermittant back-flushing of Lake Winnebago and the Oshkosh waste discharge into Lake Butte des Morts during periods of east winds (Sloey, 1970). Such occurrences would result in erroneously high nutrient concentrations (and thus loads) at the outlet sampling site (A-1). It is possible, of course, that nutrient wash-out did occur because of loss of bog materials during high water and the attending nutrient release to the waters of the lake (Ketelle and Uttormark, 1971).

Also, the losses were relatively small (7% for phosphorus and 0.6% for nitrogen), and since the mean hydraulic retention time of the lake is very short, only minimal retention of nutrients would be expected in any case.

VI. LITERATURE REVIEWED

Anonymous, 1972. Wisconsin lakes. Publ. 218-72, Dept. of Natural Resources, Madison.

Ball, Joseph R., 1973. Personal communication (lake morphometry). Dept. of Natural Resources, Madison.

Ketelle, Martha J., and Paul D. Uttormark, 1971. Problem lakes in the United States. EPA Water Poll. Contr. Res. Ser., Proj. #16010 EHR.

McKersie, Jerome R., Robert M. Krill, James L. Lissack, and Ronald K. Krueger, 1971. Wolf River pollution investigation survey. Dept. of Natural Resources, Madison.

Schraufnagel, F. H., L. A. Montie, J. R. McKersie, and Donald Winter, 1967. Report on an investigation of the pollution in the Upper Fox River basin. Dept. of Natural Resources, Madison.

Sloey, William E., 1970. "The Limnology of hypereutrophic Lake Butte des Morts, Wisconsin". Proc. 13th Conf. Great Lakes Res.

Vollenweider, Richard A. (in press). Input-output models. Schweiz. Z. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 9/30/74

LAKE CODE 550A LAKE BUTTE DES MORTS

TOTAL DRAINAGE AREA OF LAKE 5580.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
550AA1	5580.00	2281.0	2479.5	4463.1	10910.0	6545.9	5256.5	2975.4	2578.6	2876.2	2976.2	3372.1	2876.2	4130.0
550AA2	1600.00	720.00	780.00	1600.00	2700.00	1700.00	1500.00	950.00	860.00	920.00	1000.00	1100.00	870.00	1225.04
550AB1	3900.00	1600.00	1900.00	3200.00	7100.00	4400.00	3700.00	2100.00	1900.00	2100.00	2220.00	2400.00	2000.00	2875.12
550AZZ	80.00	11.00	12.00	140.00	93.00	26.00	40.00	11.00	8.80	5.00	6.40	10.00	6.80	30.92

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 5580.00
SUM OF SUB-DRAINAGE AREAS = 5580.00

TOTAL FLOW IN = 49589.99
TOTAL FLOW OUT = 49590.69

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
550AA1	9	72	5400.00	23	4200.00				
	10	72	7400.00	15	6700.00				
	11	72	6800.00	12	6800.00				
	12	72	4200.00	10	4000.00				
	1	73	5200.00						
	2	73	4300.00	11	5600.00				
	3	73	15000.00	11	18000.00				
	4	73	14000.00	1	16000.00	14	12000.00		
	5	73	18000.00	6	19000.00	20	16000.00		
	6	73	10000.00	26	6500.00				
	7	73	3400.00	14	3200.00				
	8	73	2600.00	11	2900.00				
550AA2	9	72	1700.00	24	1300.00				
	10	72	2500.00	14	2300.00				
	11	72	2200.00	12	2300.00				
	12	72	1300.00	2	1300.00				
	1	73	1800.00						
	2	73	1400.00	4	2000.00				
	3	73	5600.00	4	1500.00				
	4	73	4000.00	8	3600.00	15	3000.00	19	4200.00
	5	73	4200.00	6	4500.00	27	3200.00		
	6	73	2800.00	30	2000.00				
	7	73	1100.00	23	830.00				
	8	73	880.00	4	830.00				

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 9/30/74

LAKE CODE 550A LAKE BUTTE DES MORTS

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
550AA1	9	72	3800.00	23	3000.00				
	10	72	5400.00	15	4900.00				
	11	72	4900.00	12	5000.00				
	12	72	3000.00	10	2900.00				
	1	73	3900.00						
	2	73	3100.00	11	4000.00				
	3	73	11000.00	11	14000.00				
	4	73	9700.00	1	9400.00	14	8000.00		
	5	73	11000.00	6	12000.00	20	10000.00		
	6	73	7100.00	26	4400.00				
	7	73	2500.00	14	2300.00				
	8	73	1900.00	11	2100.00				
550AZ7	9	72	9.10	23	6.70				
	10	72	16.00	15	15.00				
	11	72	22.00	12	22.00				
	12	72	9.80	10	9.80				
	1	73	31.00						
	2	73	28.00	4	31.00	11	26.00		
	3	73	490.00	4	88.00	11	630.00		
	4	73	120.00	1	120.00	8	110.00	15	100.00
	5	73	170.00	6	190.00	20	150.00	27	130.00
	6	73	130.00	26	80.00	30	74.00		
	7	73	72.00	14	68.00	23	55.00		
	8	73	62.00	4	640.00	11	68.00		

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

550801
44 06 00.0 088 40 00.0
BUTTE DES MORTS
55139 WISCONSIN

11EPALES
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2111202
0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	09 05 0000		18.2	8.3	30	270	8.40	147	0.080	0.100	0.081	0.022
72/09/20	14 00 0000				21	258	8.70	127	0.070	0.050		0.023
	14 00 0004		23.5	7.1		260	8.60	128	0.100	0.050	0.077	0.024
72/11/09	10 10 0000				17	320	7.90	137	0.310	0.080	0.077	0.031
	10 10 0004		5.6	11.0		310	8.00	138	0.310	0.070	0.083	0.033

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	09 05 0000		21.0J
72/09/20	14 00 0000		30.8J
72/11/09	10 10 0000		51.9J

J VALUE GIVEN IS MIN [illegible]

STORET RETRIEVAL DATE 74/09/30

550802
44 06 00.0 088 40 00.0
BUTTE DES MORTS
55139 WISCONSIN

11EPALES 2111202
6 0008 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	09	15 0000	18.0	8.0	30	270	7.90	148	0.120	0.110	0.048	0.018
72/08/20	16	20 0000			20	268	8.70	130	0.060	0.070	0.076	0.020
	16	20 0004	23.6	7.5		263	8.60	131	0.060	0.190	0.105	0.032
72/11/09	09	50 0000			19	340	7.90	141	0.370	0.070	0.057	0.030
	09	50 0004	5.9	10.5		330	7.90	142	0.390	0.090	0.028	

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	09	15 0000	9.0J
72/08/20	16	20 0000	22.1J
72/11/09	09	50 0000	17.5J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/02

55043A1 L5550A1
44 02 00.0 088 34 00.0
FOX RIVER
55035 15 OSHKOSH
O/LAKE HUTTE DES MORTS
ST HWY 21 BRDG IN OSHKOSH
11FPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23	09 25		0.143	1.600	0.210	0.042	0.110
72/10/15	14 00		0.150	1.600	0.105	0.020	0.110
72/11/12	13 55		0.110	1.260	0.038	0.017	0.069
72/12/10	11 20		0.600	0.960	0.026	0.017	0.046
73/01/13	13 45		1.190	0.960	0.110	0.026	0.055
73/02/11	14 20		0.930	1.000	0.071	0.042	0.075
73/03/11	14 00		0.760	1.540	0.455	0.049	0.183
73/04/01	08 35		0.330	1.300	0.016	0.007	0.055
73/04/14	14 45		0.138	0.840	0.009	0.008	0.059
73/05/06	08 25		0.060	1.000	0.027	0.017	0.065
73/05/20	13 30		0.010	1.490	0.023	0.013	0.065
73/06/26	11 10		0.011	1.500	0.190	0.027	0.100
73/07/14	13 30		0.007	1.940	0.029	0.042	0.155
73/08/11	09 30		0.004	2.520	0.017	0.037	0.200

STORET RETRIEVAL DATE 74/10/02

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 55083A2          LS5503A2
44 02 30.0 088 45 00.0
FOX RIVER
55       15 OSHKOSH
1/LAKE BUTTE DES MORTS
ST HWY 116 BRDG IN OMRO ABOVE STP
11FPALES                 2111204
4                        0000 FEET  DEPTH
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DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	16 30		0.104	2.100	0.105	0.032	0.132
72/10/14	11 00		0.130	1.750	0.092	0.018	0.084
72/11/12	13 50		0.315	1.320	0.040	0.012	0.051
72/12/02	10 00		0.670	1.125	0.038	0.011	0.046
73/01/13	08 38		1.240	1.320	0.160	0.017	0.055
73/02/04	13 30		1.020		0.154	0.025	
73/04/09	09 00		0.017	2.500	0.038	0.019	0.050
73/04/15	12 53		0.048	1.500	0.069	0.007	0.035
73/04/19	16 00		0.035	1.375	0.012	0.008	0.035
73/05/06	09 10		0.021	1.520	0.044	0.016	0.040
73/05/27	14 20		0.092	0.960	0.073	0.062	0.110
73/06/30	11 50		0.099	1.400	0.017	0.023	0.150
73/07/23	14 15		0.081	1.900	0.022	0.020	0.135
73/08/04	09 15		0.079	2.700	0.038	0.021	0.145

STORET RETRIEVAL DATE 74/10/02

5508B1 5538A1
44 06 30.0 088 42 30.0
WOLF RIVER
55 15 OSHKOSH
I/LAKE BUTTE DES MORTS
ST HWY 116 BRDG ABV WINNECONNE STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23	10 00		0.110	1.500	0.092	0.026	0.100
72/10/15	14 30		0.110	1.300	0.068	0.023	0.091
72/11/12	14 35		0.400	1.100	0.025	0.030	0.069
72/12/10	11 00		0.520	0.790	0.024	0.025	0.042
73/01/13	14 45		1.020	0.880	0.084	0.031	0.055
73/02/11	14 00		0.870	1.100	0.105	0.036	0.075
73/03/11	14 30		0.710	1.540	0.380	0.075	0.200
73/04/01	09 00		0.252	0.850	0.010	0.008	0.050
73/04/14	15 15		0.120	0.880	0.012	0.011	0.050
73/05/06	08 45		0.027	0.980	0.014	0.015	0.065
73/05/20	13 45		0.010K	1.100	0.019	0.013	0.055
73/06/26	10 00		0.012	2.100	0.031	0.023	0.095
73/07/14	14 00		0.014	1.850	0.015	0.029	0.125
73/08/11	10 00		0.010K	1.980	0.018	0.036	0.155

K VALUE KNOWN TO BE LESS THAN INDICATED